DOCUMENT RESUME

ED 425 734 IR 019 222

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TITLE An Instrument for Projection of Resource Requirements in a Client/Server Environment: A Research Report.
PUB DATE 1998-00-00
NOTE 12p.; In: Association of Small Computer Users in Education: Proceedings of the ASCUE Summer Conference (31st, North Myrtle Beach, SC, June 7-11, 1998); see IR 019 201.
PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150) -- Tests/Questionnaires (160)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Access to Information; Case Studies; College Faculty; *Computer Uses in Education; Educational Finance; Educational Technology; Higher Education; Information Policy; *Information Technology; *Internet; *Needs Assessment; Questionnaires; Tables (Data); Teacher Surveys; Use Studies; *User Needs (Information)
IDENTIFIERS *Academic Computing; Administrator Surveys; *Client Server Computing Systems; Computer Users

ABSTRACT

The goal of this study was to determine the information technology needs at Fairfield University (Connecticut) in a client/server environment. The primary objectives were: to develop an instrument to assess the information technology needs of the user community, with particular emphasis on client/server computing and the Internet as a result of widespread access to the World Wide Web; and to establish a basis for understanding current and future economic issues of information technology acquisition. The methodology used had four stages: design the case study; conduct the case study; analyze the evidence; and develop conclusions, recommendations and implications. Six tables present data from the survey of faculty and administrators in the following categories: survey response characteristics; projected faculty computing use; specific areas in which respondents expected their need for information technology to increase over the next five years; high priority technological developments; university policies; and sources for funding. Conclusions and implications are listed, and a copy of the survey instrument is appended. (AEF)

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An Instrument for Projection of Resource Requirements in a Client/Server Environment: A Research Report

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Goal

The goal of this study is to determine the information technology needs at Fairfield University, in a client/server environment.

Objectives

The primary objectives of this study are:

1. To develop an instrument to assess the information technology needs of the user community. Particular emphasis will be placed on client/server computing and the Internet as a result of widespread access to the World Wide Web (WWW).

2. To establish a basis for understanding current and future economic issues of information technology acquisition.

Research Questions Generated by the Objectives

1. What patterns of acquisition emerge from the current computing environment and the perceived needs for computing?

2. What characteristics of the categories of computing use contribute to the patterns of acquisition?

   The Urban Information Systems Project (URBIS) conducted by the University of California, Irvine, provided the logical categories, adapted by King and Kraemer (1985) and used by Levy(1988): (a) Technological development (b)Structural arrangements (c) Socio-technical interface (d) Political economic environment, and (e) Benefits / problems.

3. How will the institution balance the need for technological changes with the need to continue the accomplishment of routine tasks?

Methodology

The methodology used in this study will follow the recommendation of Yin (1994) and has four stages: 1) Design the case study, 2) Conduct the case study, 3) Analyze the case study evidence, and 4) Develop the conclusions, recommendations and implications.

Case study research is not sampling research; that is a fact asserted by all the major researchers in

the field, including Yin, Stake, Feagin and others. The unit of analysis is a critical factor in the case study. Case studies are multi-perspectival analyses. This means that the researcher considers not just the voice and perspective of the actors, but also of the relevant groups of actors and the interaction between them.

Case study is known as a triangulated research strategy. Snow and Anderson (Feagin et al, 1990) asserted that triangulation can occur with data, investigators, theories, and even methodologies. Stake (1995) stated that the protocols that are used to ensure accuracy and alternative explanations are called triangulation. The need for triangulation arises from the ethical need to confirm the validity of the processes. In case studies, this could be done by using multiple sources of data (Yin, 1984). The problem in case studies is to establish meaning rather than location.

For this case study, the researcher replicated Levy's (1988) study, but also adds to the field by examining aspects of client/server computing, the Internet, and the WWW. It is based on a modification of the methodology devised by Yin (1984).

1. Design the case study protocol:
   determine the required skills
   develop and review the protocol
2. Conduct the case study:
   prepare for data collection
   distribute questionnaire
   conduct interviews
3. Analyze case study evidence:
   analytic strategy
4. Develop conclusions, recommendations, and implications based on the evidence

Results

The results of the survey were tabulated using SPSSx version 7 running on a Pentium PC 75 megahertz under Windows 95. The results are excerpted from the original study to conform the requirements of this publication.

Table 1
Survey Response Characteristics

Survey Type	# Distributed	# Respondents	% Response
Faculty	191	88	46
Administrators	22	14	64

It is clear from the data above that the response rate was sufficient to conduct the planned statistical tests. The response was representative of the faculty and the administrators and was considered adequate for this study.

Table 2
Projected Faculty Computing Use
N=88

Item	Question	%Increase	%Decrease	%Same
3	Number of Applications	93	0	7
4	Amount of time spent	86	1	13
6	Data communications	87	1	12

Table 2 indicates the potential for increased resource requirements in the near future. The projection is for significantly increased use of information technology.

Table 3 below shows that the respondents expect their need for specific information technology items to increase over the next five years. Items relating to database access and the Internet are particularly important to the users.

Table 3
Important in Next 5 Years (Faculty)
N=88

				*		Cross Tabulations				*	
		All		*	A&S	Business		Nursing		GSEAP	
Item	Question	A	D	A	D	A	D	A	D	A	D
39	Dept support for net PC	51	28	44	34	64	7	40	20	100	0
63	More LANs	70	4	70	4	71	7	75	0	80	0
64	Search library holdings	95	5	92	0	100	0	100	0	100	0
65	Database Search	98	0	96	0	100	0	100	0	100	0
66	Off campus computing	82	2	79	4	100	0	80	0	100	0
67	Email	85	1	88	2	57	0	100	0	100	0
68	Students PC	78	4	75	4	79	7	100	0	67	0
69	Off campus email	82	2	83	2	64	7	14	50	100	0
70	Laser printing	95	2	92	4	100	0	100	0	100	0
71	Test scanning	45	13	39	14	50	14	100	0	83	0
72	Upgraded PC	93	5	90	6	93	7	100	0	100	0
73	Video conference	57	8	54	12	50	7	100	0	67	0
74	OCR	75	4	67	6	93	0	100	0	100	0
75	Voice recognition	33	12	34	16	21	7	50	0	50	0
76	Database browsing	83	1	83	0	19	0	75	0	100	0
77	Video capture	59	7	54	8	50	14	75	0	83	0
78	Access to WWW	95	5	94	0	93	0	100	0	100	0
79	Class access networked CD	77	24	71	0	86	0	100	0	83	0
80	Class material on WWW	74	2	71	4	62	0	100	0	67	0

(A = % Agree; D = % Disagree; Neutral = A - D; A&S = Arts & Sciences; %Business = School of Business; %Nursing = School of Nursing; GSEAP = Graduate School Of Education & Allied Professions)

Context of Computing Use

The King and Kraemer (1985) categories were adapted by Levy (1988) for his study. The survey items in the questionnaires used by Levy (1988) and in this study also fell into those categories as follows:

In the Faculty Survey the items that fell into each category were:

Technological Development, items 39,63-80,82-102,107-116
Structural Arrangements, items 16-17,38
Socio-Technical Interface, items 18,51-62,117,120
Political/Economic Environment, items 19,40,42-50,104-105,118-119
Benefits/Problems, items 25-37,106

Technological Developments

Table 4
High Priority Should be Placed on (Faculty)
N=88

		All	*	Cross Tabulations A&S		Business		Nursing	*	GSEAP	
Item	Description	A	D	A	D	A	D	A	D	A	D
114	Access to WWW	80	7	76	10	93	0	80	0	67	17
115	Access to Instructional labs	71	5	67	6	77	8	80	0	50	0
116	Access to Student labs	70	6	69	6	64	14	100	0	33	0

(A = % Agree; D = % Disagree; Neutral = A - D; A&S = Arts & Sciences; %Business = School of Business; %Nursing = School of Nursing; GSEAP = Graduate School Of Education & Allied Professions)

Table 4 shows that instructional uses are expected increase and that the users are expecting additional resources to be available.

Structural Arrangements

Table 5
University policies (Faculty)
N=88

		All	*	Cross Tabulations A&S		Business		Nursing		* GSEAP	
Item	Description	A	D	A	D	A	D	A	D	A	D
16	Univ has effective guidelines	12	63	11	68	7	43	20	80	33	33
17	Univ allocates resources equitably	19	55	19	61	0	36	0	80	50	17
38	Satisfied with computing decisions	7	68	11	66	0	71	0	67	0	50

In Table 5 the respondents indicate their dissatisfaction with the institution's computing policies and their ability to influence decisions regarding their computing needs.

Political/Economic Environment

Table 6 below shows the rejection of all the choices for funding information technology acquisition. The users project increased usage and the need for additional resources, but cannot accept a reduction in any area that might provide the funds for acquisition of resources.

Table 6
Sources for funding (Faculty)
N = 88

		*		Cross Tabulations						*	
		All	*	A&S		Business		Nursing		GSEAP	
Item	Description	A	D	A	D	A	D	A	D	A	D
19	All student access computers	97	1	96	2	100	0	100	0	83	0
40	Frequently approached by vend	14	73	15	77	7	79	0	50	17	50
42	From Faculty positions	3	90	0	92	0	85	0	100	0	100
43	From Support positions	29	56	32	55	23	46	67	33	25	50
44	From other equipment	36	44	29	44	54	31	75	25	50	50
45	From Professional Travel	11	72	6	71	23	62	0	100	0	100
46	From Plant Maintenance	26	53	23	51	31	54	25	50	75	25
47	From New Programs	43	42	47	35	39	54	33	67	50	50
48	From Salary Increase	5	76	2	73	15	69	0	100	0	100
49	From Current Instruction Programs	27	60	28	55	23	69	33	33	50	50
50	Current Support Programs	23	65	37	49	15	46	60	20	60	20

Future Research

A factor analysis was run on the Fairfield University data, on each of the five King and Kraemer (1985) groupings of variables that were adapted for use in a study of the University of Arizona by Levy (1988). New factors emerged in each of the categories. The new factors that were selected had factor loadings of .6 and higher. Further analysis could be carried out using the new variables as part of a cross tabulation, or some other statistical test.

Conclusions

Some of the conclusions from the data analysis, interviews, and literature are:

1. Institutional planning for information technology is inadequate.
2. A shorter planning cycle is needed for information technology.
3. Allocation of resources is not equitable among users.
4. Users are dissatisfied with their ability to influence computing decisions.
5. Faculty and administrators did not accept any potential sources of funding for Info. Tech.
6. Faculty and administrators felt that computing enhanced the scope of their work.
7. The expenditures and procedures for implementation of client/server computing were not carried out in a systematic and documented manner.
8. The equipment acquisition procedures are not responsive to user needs either in terms of pricing or timeliness.
9. There is a low level of user confidence in network integrity.
10. The faculty expect to use networked PC's in the classrooms.
11. User productivity is lowered due to resource allocation problems, and other technology issues.

12. There will be a significant increase in the use of the Internet and WWW by faculty over the next five years, which will require a well-designed client/server environment.
13. The shift to client/server computing will result in higher financial burdens.
14. There is no formal procedure to configure the servers using capacity planning procedures.
15. Multimedia classrooms for instruction and support will be needed in the near future.

Implications

1. In a client/server computing environment formal capacity planning procedures need to be instituted, to ensure properly configured servers and adequately equipped client systems.
2. As the pace of technology advance accelerates, desktop systems are likely to become more capable than the server. This could present problems in the delivery of service and result in bottlenecks. The client/server environment must be continually monitored for efficiency.
3. A budget item must be included for information technology so that the expenditure for acquisition is part of the institutional planning process.
4. The information technology planning cycle should be shortened so that the institution is in a position to respond to the rapid pace of technology change.

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Appendix I
Survey Instrument

Faculty Assessments of Computing

Thank you for participating in this survey. Additional comments would be greatly appreciated, and space is provided at the end of the survey. To return, simply fold the survey the opposite way, and return through campus mail.

1. Estimate your time spent in the following areas (total 100%)
   ___% Instruction ___%Public Service
   ___% Research ___%Administration
   ___% Academic Support ___%Univ Service

2. Do you use computing or have the knowledge of computing activities at the university? ___ yes ___ no

If you answered no, please respond to items 17, 25-31, and 41-49 and return the survey.

3. In the next year, the number of computing uses/applications you use will: ___ increase ___ decrease ___ remain the same

4. In the next year, the amount of time you spend using computing will: ___ increase ___ decrease ___ remain the same

5. Which of the following best describes you as a computer user? (If more than one is appropriate, please rank)

___ I use the computer for Word-processing most of the time

___ Use Package software or software provided by others to access data or use applications through a menu-driven format or another set of procedures.

___ Understand the use of database and able to specify, access, and manipulate information or instructional Applications.

___ Utilize computer languages directly for your own Information needs. Develop your own applications, some of which are used by others.

___ Support other computer users within their areas. Though not a professional programmer or data processing professional., you are called upon by others for assistance.

___ While not a direct computer user, you benefit from computer applications in your work through conceptualization of work to be performed, or the direction of co-workers and subordinates.

___ Employed, at least in part, for computer expertise. Formally support end user activities, and perhaps involved in information systems management, computer instruction/training, and programming.

6. In the next year, your data communications needs will: ___ increase ___ decrease ___ remain the same

Please check any of the following that describe your computing uses or needs:

	Currently use	Could use now	Would enhance future work
7. Internet resources (Gopher, FTP etc)	____	____	____
8. World Wide Web (WWW) resources Netscape etc	____	____	____

9. Networked PC access from classroom	____	____	____
10. Artificial intelligence/expert systems	____	____	____
11. Enhanced or complex graphics abilities	____	____	____

12. Would you use a computer during instruction if it were available on campus with consulting support?
(Please check) ____ yes ____ no ____ need information

13. Please check any of the following computing design and acquisition activities in which you have been involved:

1. ____ Review of designs for new applications
2. ____ Providing test data for an application
3. ____ Approve or sign off on an application
4. ____ Working as a member of a technical group in designing an application
5. ____ Sitting on a policy board/committee overseeing computing use/resources
6. ____ Participating in assigning priority of data processing projects
7. ____ Participating in decision making about types/brands of hardware and/or software to be acquired
8. ____ Participating in determining allocation of resources for the acquisition of computing

14. If you currently use the VAX 6430, what would you prefer to use if the system were no longer available? (Please check)

1. ____ Not a user of the VAX 6430
2. ____ Networked Multimedia Microcomputer
3. ____ IBM system (other than PC)
4. ____ Technical Workstation (Sun/Other)
5. ____ Alpha
6. ____ Remote computer

15. Please describe the way you do your computing work by the number of hours each week in each category

System Type	StandalonePC /Mac	Mainframe	Networked PC/Mac
Personal			
Departmental			
College/School			
University			
Off Campus			

Please circle the appropriate option from the scale of each item.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
16. University policy has provided effective guidelines for computing use in the university.	SA	A	N	D	SD
17. The University's central administration has been equitable in allocating available resources for computing.	SA	A	N	D	SD
18. Hands -on workshops designed specifically for faculty and research uses of information technology tools would be useful for me.	SA	A	N	D	SD
19. All students should have access to computing, regardless of the courses which they are enrolled in.	SA	A	N	D	SD

The following have strongly influenced my views about the use of information technologies in universities:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
20. Personal Experience	SA	A	N	D	SD
21. Professional journals and conferences	SA	A	N	D	SD
22. Opinions of peers	SA	A	N	D	SD
23. News media and popular literature	SA	A	N	D	SD
24. Advice from vendors/consultants	SA	A	N	D	SD
25. The scope of the work I am able to undertake is directly increased by the use of computing.	SA	A	N	D	SD

The current computing resources of the university are an asset in:

26. Attracting undergraduate students	SA	A	N	D	SD
27. Attracting graduate students	SA	A	N	D	SD
28. Attracting faculty	SA	A	N	D	SD
29. Attracting sponsored research	SA	A	N	D	SD
30. Attracting alumni support	SA	A	N	D	SD

31. Attracting corporate donations/grants	SA	A	N	D	SD
32. Forming joint ventures with private sector	SA	A	N	D	SD

As a user of university mainframe computing resources, I am:

If you are not a user please check the box on the right and proceed to question 39: ____ not a user

33. Able to effectively discuss needs with support staff	SA	A	N	D	SD
34. Satisfied with available applications	SA	A	N	D	SD
35. Satisfied with system response time	SA	A	N	D	SD
36. Satisfied with the access to data for which I have clearance	SA	A	N	D	SD
37. Satisfied with institutional data sets available for analysis	SA	A	N	D	SD
38. Satisfied with our level of computing decisions	SA	A	N	D	SD
39. There is considerable support for the acquisition of PC networks within my department/unit	SA	A	N	D	SD
40. I am frequently approached by computer vendors and/or outside consultants	SA	A	N	D	SD
41. In my area, the computing resources of the University compare favorably with computing resources in our peer universities	SA	A	N	D	SD

Resources for the acquisition and maintenance of computing would come from the reallocation of funds from:

42. Faculty positions	SA	A	N	D	SD
43. Support positions	SA	A	N	D	SD
44. Other equipment and supplies	SA	A	N	D	SD
45. Professional travel/Conferences	SA	A	N	D	SD
46. Plant and equipment maintenance	SA	A	N	D	SD
47. New programs	SA	A	N	D	SD
48. Promotions and salary increases	SA	A	N	D	SD
49. Current instructional programs	SA	A	N	D	SD

The following contribute to the effectiveness of my current computing work:

50. Current support programs	SA	A	N	D	SD
51. Frequently upgraded personal computer	SA	A	N	D	SD
52. Sufficient data communications capabilities	SA	A	N	D	SD
53. Appropriate computing resources	SA	A	N	D	SD
54. Appropriate software	SA	A	N	D	SD
55. Good documentation	SA	A	N	D	SD
56. Sufficient training	SA	A	N	D	SD
57. Sufficient consulting	SA	A	N	D	SD
58. Sufficient support staffing	SA	A	N	D	SD
59. Effective support staffing	SA	A	N	D	SD
60. Access to the Internet, WWW, E-Mail, from the Office	SA	A	N	D	SD
61. Access to the Internet, WWW, E-Mail from the classroom	SA	A	N	D	SD
62. Access to the Internet, WWW, E-Mail from Home	SA	A	N	D	SD

The following computing developments are or will be important to the Fairfield University within the next five years:

63. More Local area networks	SA	A	N	D	SD
64. On-line search of library holdings from the office	SA	A	N	D	SD
65. On-line search of national databases from the office	SA	A	N	D	SD

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
66. Access to off-campus computers	SA	A	N	D	SD
67. Access to on-campus electronic mail	SA	A	N	D	SD
68. Require all students to have network ready personal computer	SA	A	N	D	SD
69. Access to off-campus electronic mail or bulletin boards	SA	A	N	D	SD
70. Access to convenient Laser printing	SA	A	N	D	SD
71. Convenient access to scanned test scoring	SA	A	N	D	SD
72. Frequently upgraded personal computers	SA	A	N	D	SD
73. Video conference capability	SA	A	N	D	SD
74. Optical scanning/character recognition devices	SA	A	N	D	SD
75. Voice recognition and compound documents	SA	A	N	D	SD
76. Software assistance for browsing databases	SA	A	N	D	SD
77. Video capture/playback capability	SA	A	N	D	SD
78. Access to the Internet and WWW	SA	A	N	D	SD
79. Access to networked CD's from classroom	SA	A	N	D	SD

80. Ability to create class material for use on the WWW	SA	A	N	D	SD
81. Other _____					

Fairfield University should place high priority on the following services:

82. Up-to-date microcomputer-based instructional labs	SA	A	N	D	SD
83. More mainframes	SA	A	N	D	SD
84. More disk capacity on mainframe (VAX) and servers	SA	A	N	D	SD
85. More powerful network servers	SA	A	N	D	SD
86. Microcomputer classrooms for instruction only	SA	A	N	D	SD
87. Multimedia classrooms for instruction only	SA	A	N	D	SD
88. More laserprinting	SA	A	N	D	SD
89. More documentation	SA	A	N	D	SD
90. More training	SA	A	N	D	SD
91. More consulting support for instruction	SA	A	N	D	SD
92. More consulting support for research	SA	A	N	D	SD
93. More communications (data/voice)	SA	A	N	D	SD
94. Programming for university supported systems	SA	A	N	D	SD
95. Programming for non-university systems	SA	A	N	D	SD
96. Maintenance of department-owned equipment	SA	A	N	D	SD
97. Software maintenance on department equipment	SA	A	N	D	SD
98. More classrooms connected to the networks	SA	A	N	D	SD
99. Support for WWW/multimedia course development	SA	A	N	D	SD
100. More instructional software	SA	A	N	D	SD
101. Ability to transfer large files with sound, images etc	SA	A	N	D	SD
102. Ability to scan and store documents on WWW for instructional use	SA	A	N	D	SD

103. Other(s) _____

104. There is sufficient support for instructional computing in my department	SA	A	N	D	SD
105. There is sufficient support for instructional computing in the university	SA	A	N	D	SD
106. Within the next five years, computing could improve/enhance the functions associated with my instructional work.	SA	A	N	D	SD

Instructional uses of computing, where appropriate, are assisted by:

107. Sufficient amount of quality software/courseware	SA	A	N	D	SD
108. Sufficient number of available multimedia workstations	SA	A	N	D	SD
109. Sufficient training and development for faculty	SA	A	N	D	SD
110. Sufficient incentives for software development for faculty	SA	A	N	D	SD
111. Software at affordable prices for use on PC networks	SA	A	N	D	SD

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
112. Sufficient data communications capabilities	SA	A	N	D	SD
113. Current personal computer equipment	SA	A	N	D	SD
114. Access to the Internet and WWW	SA	A	N	D	SD

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
115. Access to labs for instruction	SA	A	N	D	SD
116. Access to labs for student to practice/assignments	SA	A	N	D	SD
117. I would use the services of an Instructional Computing group to help faculty use computing for instruction.	SA	A	N	D	SD
118. There is sufficient support for research computing in my department	SA	A	N	D	SD
119. There is sufficient support for research computing in the university	SA	A	N	D	SD
120. I would use the services of a Research Computing group to help researchers use computing in their research	SA	A	N	D	SD

121. I subscribe to Listserves/Bulletin Boards ___ Yes ___ No

122. I use the Internet for the following purposes on a daily basis:

Internet Activity	Percentage of Daily use
Instruction	
Research	
Professional Interest	
Email	
Personal Interest/Surfing	
Total	100%

Department _____
School _____
Gender _____